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A Study of Some Ergatogynic Ants.

By

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Contributions from the Zoological Laboratory of the University of
Texas.

With 16 fig. in the text.

Morphologically considered, the sexual phases of ants, as is well known, are male, queen and worker: the idea is prevalent that a corresponding physiological distinction exists; the male having the function of producing spermatozoa, the queen that of producing eggs, the worker that of carrying on all the other functions necessary to the life of the colony. Naturally morphological characteristics were first recognized and have been more widely used in classification than those of a physiological nature. One of the most universally true and therefore most widely used, morphological characteristics is the structure of the thorax. This is especially true with regard to the separation of the queen and worker, since the worker usually shows a reduction or simplification in this region of the body. However, with an increase in the knowledge of the various species, the importance of the thoracic structure as a distinguishing characteristic has become lessened and indeed ADLERZ does not give it as one of the characteristics which serve as factors for classification, although he himself uses it. In his *Myrmecologische Studien* in summarizing the knowledge concerning ants he says: „We know

that those characteristics that distinguish the typical worker from the queen are partly of a retrogressive nature, for example the reduction of the receptaculum seminis, ovaries, eyes, wings, together with their muscles and muscular attachments, and partly progressive, for example the increased size of mandibles and their muscles...." Gradually these morphological distinguishing characteristics have been rendered more and more useless as perfectly sure factors for purposes of classification. The value of the wings was lessened when ergatoid females, without even any traces of the wing sutures were discovered; then queens and workers were found with similar thoracic structure, and thus we see the distinguishing factor has been pushed gradually back to the organ in the individual most important phylogenetically, the reproductive organ. The male, of course, can thus be distinguished readily, and the separation of the queen and worker has been based finally on the condition of the ovaries as the determining factor.

Exact knowledge of the morphological and physiological conditions of the ovaries of ants is still somewhat meager, and it seems to be accepted as a fact that the ovaries of worker ants are more or less rudimentary organs, sometimes to the point of complete sterility, possessing fewer tubules than those of the queen. Without doubt this is the condition in some species. The work of WASMANN and Miss BICKFORD shows that morphologically, in some ants at least, there is no reason why workers in natural conditions should not produce eggs, and indeed ADLERZ says in his summary, "We know that the workers of most ants may lay eggs capable of development, and that their ovaries thus, in spite of reduction in the number of tubules, cannot be considered as rudimentary, if by this term we mean not only lack but also decrease of function." The question then is a physiological one: do they produce eggs capable of development?

When the condition of the ovaries was taken as a distinguishing characteristic between the queen and worker, the receptaculum seminis was immediately thought to be the surest means for determining the functioning power of the ovaries, and ADLERZ declares: "C'est par la présence de receptaculum seminis que certains individus prouvent leur capacité à remplir les fonctions d'une femelle, et les véritables femelles de cette espèce." Thus according to this statement all ants possessing the receptaculum seminis must be

considered as queens, and the problem before us is to determine if the facts warrent such an assumption.

Whenever possible fresh material has been used for dissection, and this was possible with nearly all of the Texas forms throughout the entire year; sometimes, however, during the winter months alcoholic specimens had to be used. The conditions existing in the queen were first determined whenever possible, and that of the worker compared with it.

Repeated observations on some of the ants most common in the vicinity of Austin, viz. the *Ponerinae*, nests of which are frequently found containing eggs, larvae, pupae, workers and sometimes males, but no queen, have lead to this study of the condition of the ovaries in these forms.

I. *Ponerinae*.

The representatives of the *Ponerinae* studied are the *Leptogenys elongata* BUCKLEY, *Pachycondyla harpax* FABR., *Odontomachus clarus* ROG., which have been described by

Dr. WM. M. WHEELER
(WHEELER 1900).

Leptogenys elongata BUCKLEY.

In the *Leptogenys* nests, which are small and somewhat frequent, the queens are usually present; their occasional absence may be accounted for by their rapid flight. The absence of the queens is more noticeable in the winter months, probably due to them having taken up their winter quarters deeper in the nests. In the spring they are again obtained very frequently. Two types of ovaries existed in the

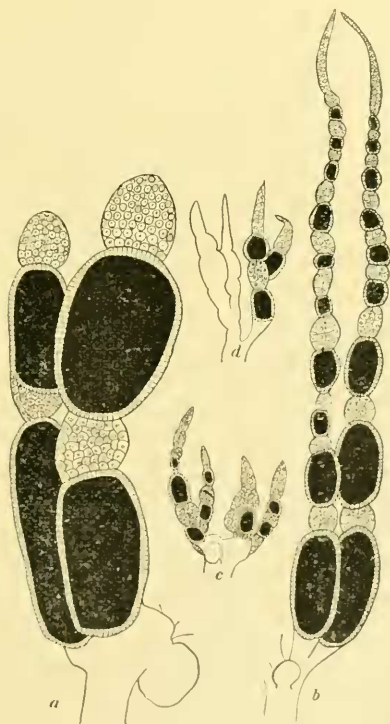


Fig. A.

Leptogenys elongata BUCKLEY.

- a Ovary of queen possessing short tubules;
- b Ovary of queen with long tubules;
- c Ovary of worker with receptaculum seminis; d Ovary of workers.

queens dissected; one having long, slender tubules with quite a number of eggs, as many as fifteen to a tubule (Fig. A b), the other having short tubules and therefore fewer eggs (Fig. A a). Only two ovaries of the first type were found, each possessing two tubules to a side, the second type usually had just two eggs to a tubule, but sometimes one and sometimes even three. The second type also varied in the number of tubules on each side. Of the eight queens five, represented by the second type, had two tubules to a side; one had three on each side; the other two varied, having three on one side and two on the other. A typical receptaculum seminis was present in both types of ovaries.

The condition in the workers was next determined. No ovaries were obtained from quite a number of the workers dissected, probably on account of the small size of the ovaries and my lack of skill. The number of tubules varied here also as in the queen: eight individuals had three tubules on a side, four had two on one side and three on the other; the remaining specimens had two on each side. Very frequently the tubules were not well developed; others, however, contained apparently normal and mature eggs, one to a tubule. Among the mounted ovaries a very surprising discovery was made — the ovary of an ordinary worker, indistinguishable externally from its fellows, possessed a typical receptaculum seminis! This ovary had two well developed tubules to each side, and each contained one normal and mature egg at its proximal end (Fig. A c).

The following table shows the variations in the number of tubules of the ovaries in the different forms:

Form	No. of ovaries	No. of tubules on each side
Queen	5	2 and 2
"	1	3 " 3
"	2	2 " 3
"	2	2 " 2
Worker	8	3 " 3
"	4	3 " 2
"	6	2 " 2

It is interesting to note that in regard to external anatomy also the queen is represented by two types; one in which the node, the distinguishing characteristic, is like that of the worker; in the other type it is like that of the male. Seven of the former and

two of the latter were found, while in one specimen, perhaps an anomaly, the node was fastened directly to the abdomen, in fact was fused with it.

Pachycondyla harpax FABR.

The *Pachycondyla* nests are small but of frequent occurrence; the number of individuals to a nest varies from ten to a hundred. Most of the nests discovered contained from ten to twenty members only, a few were very large, however. The latter is especially true in late spring, but very small nests were found even in early summer. Very often a single individual, indistinguishable from the worker, is found under a stone, as if preparing to found a new nest or colony. During one afternoon eight such individuals were collected.

Out of many nests discovered only two queens were found and the ovaries in these were in a very undeveloped state; the tubules were very long and slender and contained no eggs. The number of tubules varied in the two forms, one having five on each side, the other having five on one side and seven on the other. The receptaculum seminis was present in both queens, situated high up on the vagina, very near the middle of its length.

Notwithstanding the absence of queens, the nests contained eggs, larvae and pupae. A very noticeable thing was the presence of a great number of winged males in the nests. In one which contained only eight workers, but no queen, twenty winged males were present. In all of the nests, even in those containing queens, workers occurred with well developed ovaries, having normal tubules, containing large and apparently normal, mature eggs.

Of the thirty-seven *Pachycondyla* workers dissected, seven had the receptaculum seminis, well developed tubules and eggs. The number of tubules varied greatly in the individuals as well as in the two sides of the same ovary. Usually two eggs were ripe at a time, but when the number of tubules were larger there was one ripe egg to each tubule. These workers with the receptaculum had longer tubules and therefore more eggs to the tubule than the ordinary worker. These forms are not distinguishable by their external anatomy from those not possessing the receptaculum. Thirty ordinary workers were examined; the tubules varied considerably, it being exceptional to have the same number of tubules on each side of the ovary. The tubules varied in number from two to nine;

the eggs, varying from two to three in each tubule, were normal and mature and occurred usually one to each tubule.

The following table shows the variation in the several forms.

Form	No. of ovaries	No. of tubules on each side
Queen	1	5 and 5
"	1	5 " 7
Worker with receptaculum	2	4 " 5
	2	5 " 5
	1	7 " 5
	1	5 " 6
	1	5 " 3
Workers	6	4 " 5
	4	5 " 6
	3	4 " 4
	3	6 " 7
	3	5 " 7
	3	3 " 6
	2	6 " 6
	2	5 " 6
	1	4 " 3
	1	3 " 3
	1	2 " 2
	1	9 " 6

Of the eight individuals occurring under stones, four had the receptaculum seminis, well developed tubules and mature eggs. The tubules varied in number just as in the other forms. Two were ordinary workers without the receptaculum, but possessing large tubules and mature eggs. The others died during my absence from the laboratory and were not dissected on that account.

From these conditions it would seem that the *Pachycondyla* workers with the receptaculum seminis can and do function as queens, but whether or not there was always one or more such workers in those nests not containing a queen was not determined in every case unfortunately; but it was the condition where ever noted. It would seem that the ovaries of the workers without the receptaculum seminis are functional since they are so highly developed, but proof is wanting. As the unfertilized eggs, in some ants at least, develop into males, this may be the explanation for the large number of males existing in so many nests. Here also in every worker dissected the ovaries were not developed sufficiently to be detected; in fact nearly half of those dissected were in this condition.

Odontomachus clarus Rog.

Although the nests of *Odontomachus* are comparatively rare, they are larger than those of the other two species of the *Ponerinae*, since they contain from one hundred to two hundred individuals.

Only three queens were obtained for dissection. The ovaries of these, however, were well developed and the number of tubules constant, five on each side. Usually there were several eggs to a



Fig. B.

Odontomachus clarus Rog.

- a Ovary of queen; b Ovary of worker with the receptaculum seminis;
c Ovary of worker.

tubule and generally two or three were mature at the same time, one to a tubule. The receptaculum was present in all three queens, situated about the middle of the vagina. Attached to the receptaculum by a slender tube was an organ shaped like a three leaf clover. From its structure this organ is evidently a gland, as each of the three little sacs consisted of a single row of columnar cells surrounding a cavity which in some cases was filled with secretion (Fig. B a).

A fact still more surprising was the presence of this gland in connection with the receptaculum in ten workers, which to all appearances were otherwise normal. The ovaries in these forms were like those of the queen with the exception that they varied in the number of tubules: the constancy of the queen, however, is not certain as too few were dissected to determine whether this is the normal condition. The ovaries of these workers have from three to eight tubules on each side (Fig. B b).

The ovaries of the ordinary workers also, that is, those without the receptaculum, were well developed and contained eggs. Quite a number had mature eggs in them, one to a tubule. The tubules varied from two to eight, with great variety between these limits (Fig. B c). The variation in the several forms is as follows:

Form	No. of ovaries	No. of tubules on each side
Queen	3	5 and 5
Worker with receptaculum	3	5 " 5
	2	7 " 4
	1	6 " 8
	1	6 " 6
	1	5 " 7
	1	5 " 6
	1	3 " 3
Worker	6	6 " 6
	2	5 " 5
	2	8 " 8
	3	4 " 4
	1	4 " 7
	1	4 " 6
	1	4 " 5
	1	2 " 3
	1	7 " 5

Here also every worker dissected did not have ovaries large enough to be distinguished. In the forms collected in the spring the majority had them sufficiently large to be detected, in the winter a greater number did not, as would be expected.

The results of this study, viz. the discovery of the receptaculum in the ovaries of forms other than queens naturally brought up the question whether such conditions are anomalies, occurring in such ants as the *Ponerinae*, where the morphological distinction between the queen and worker is very slight, or whether like conditions exist also in species where the morphological distinction between the queen and worker is great.

II. *Leptothorax emersoni* WHEELER.

At this time there was put in my hand a most interesting little ant, the *Leptothorax emersoni*, from Colebrook, Conn., recently discovered and named by Dr. Wm. M. WHEELER (WHEELER 1901).

Differences were immediately noticed in the size of the ants, and a separation based on this was begun when it was discovered that other and more important differences existed, namely the presence of ocelli in some and variations in the structure of the thorax. The division based on these more fundamental differences is, however, not perfectly satisfactory since the groups overlap each other to some extent. Queens, microgynes, ergatoid females, tri-, bi-, and uni-ocellate workers, macro- and micro-ergates were readily distinguished on careful examination. The queens, microgynes and ergatoids do not vary greatly in size, but when ocellate workers are reached, forms occur, regardless of thoracic structure, varying in size from those as large as the queen or ergatoid to those as small as the most minute microërgates. The following table is given to show the different forms that occur. Numbering is begun with the microërgates.

Females	Winged	XI. Queen				
		X. Microgynæ				
	Apterous	Ocellate workers	Tri-ocellate	VIII. scutellate	(a)	large scutellum
					(b)	small scutellum
			Bi-ocellate	VII. escutellate		
				VI. scutellate	(a)	large scutellum
			Uni-ocellate	V. escutellate	(b)	small scutellum
				IV. scutellate	(a)	large scutellum
				III. escutellate	(b)	small scutellum
					II. Macroërgate	
		I. Microërgate				

The queen, microgynic and ergatoid forms have three ocelli. The thorax of the queen is very nearly typical.¹⁾ The pronotum and sternite of the prothorax, the mesonotum, paraptera, scutellum and wings of the mesothorax are all distinctly separated; the epimerite, episternite and sternite are not distinct. In the metathorax the metanotum, wings and epimerite are distinctly separated. the

1) Nomenclature from EMERY (Intorno al torace delle Formiche.)

epinotum of the first abdominal segment, and the episternite and the sternite have fused. In the region of the sternite the orifice of the scent gland is present (Fig. Ca and Fig. Da).

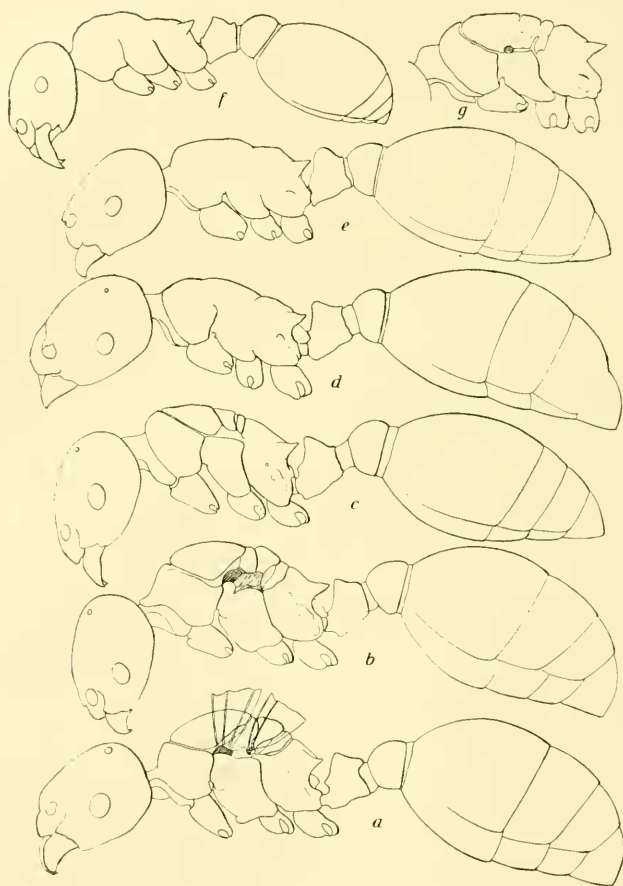


Fig. C.

Leptothorax emersoni WHEELER.

a Queen; b Ergatoid female; c Trioculate works, type VIIa; d Biocellate worker, type VIb; e Macroergate, type II; f Microergate, type I; g Ergatoid formes, having sutures for fore wings only.

The microgyne is like the queen but smaller.

The ergatoid has all the parts of the thorax just as in the queen with the exception of the wings, of which the sockets only are present (Fig. Cb and Fig. Db).

A single individual was found possessing the sutures for the fore wings only. The pronotum and sternite of the prothorax are distinctly separated; dorsally the mesonotum, scutellum and the metanotum are distinct, but they gradually fuse and become in-

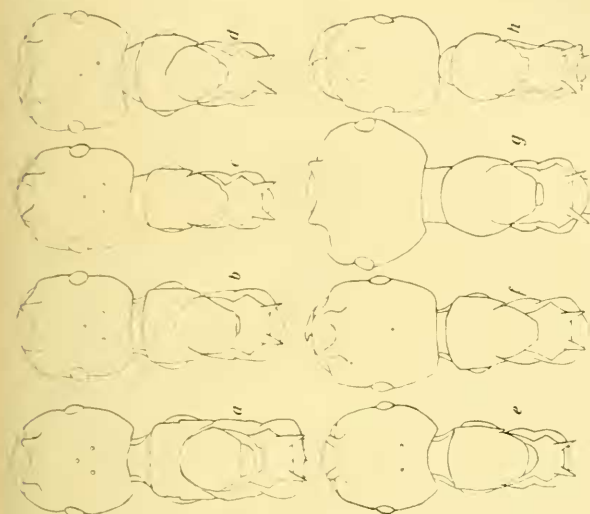


Fig. E.

Leptothorax emersoni WHEELER.

a Triocellate worker, type VIIIa; b Triocellate worker, type VIIIb; c Triocellate worker, type VII; d Triocellate worker, type VIa; also the thorax of type VIa; e Biocellate worker, type VIb, also the thorax of type IVb; f Unicellate worker, type III; also thorax of type V; g Macroergate, type II; h Microergate, type I.

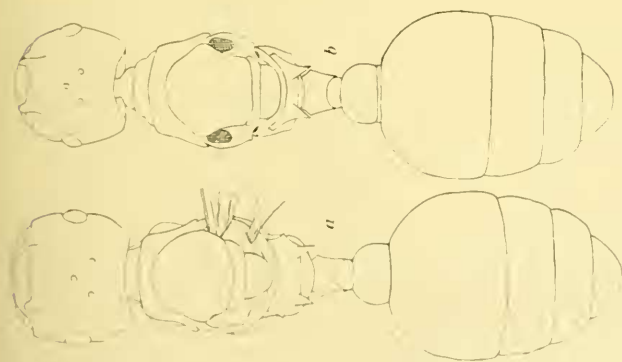


Fig. D.

Leptothorax emersoni WHEELER.

a Dorsal view queen, type XI.
b Dorsal view of ergatoid female, type IX.

distinguishable laterally, as do also the tegulae, paraptera, epimerite, episternite and sternite. In the metathorax the epinotum, sternite and episternite have fused, as has the epimerite with the metanotum (Fig. C'g).

The next type distinguished is that of the tri-ocellate worker, which is represented by individuals with variations in the structure of the thorax. The first type, VIIIa, has the typical pronotum; the mesonotum and scutellum are distinctly separated, a wide suture occurs where the paraptera are expected; the sternite, epimerite and episternite have fused. In the metathorax the metanotum is distinct, the epinotum and sternite have fused (Fig. Cc and Fig. Ea). The second type, VIIIb, has a small scutellum but no mesonotum, it having fused with the epinotum and sternite (Fig. Eb). The third representative of the tri-ocellate workers, VII, has no suture between the pro- and meso-notum nor between the mesonotum and the scutellum (Fig. Ec).

The biocellate group also is represented by the three different forms. The first having a distinct pronotum and mesonotum, and a large scutellum, VIa (Fig. Ed), the second having a scutellum but no suture between the pro- and meso-notum, VIb (Fig. Cd and Fig. Ee), the third having no scutellum and no suture between the pro- and meso-notum, that is, the thorax is like that of III (Fig. Ef). There is also a difference in the arrangement of the ocelli in these forms (Fig. Ed, e), but this difference occurs without regard to the structure of the thorax. Some had both ocelli in the posterior position; sometimes, however, the right posterior ocellus and sometimes the left was present along with the anterior one.

The uni-ocellate workers also show a difference in the ocellus present, all the possible differences being shown. Sometimes the anterior ocellus is present, sometimes the right posterior, sometimes the left. Here also the three different types, in regard to the structure of the thorax are seen, just as in the other forms (Fig. Ed, e, f).

The macroërgate has a small scutellum, distinctly separated from the mesonotum dorsally; laterally, however, the different parts of the three thoracic segments have fused except for a short distance from the ventral aspect (Fig. Cc and Fig. Eg). While dissecting some of the macroërgates in order to determine the structure of the mouth parts one specimen, otherwise normal, was found possessing antennae with twelve joints in place of the specific number, eleven, and maxillary palps with six joints whereas the specific number is five.

The microërgates have the same undifferentiated structure, only

somewhat more accentuated, in that the scutellum is not distinctly separated from the mesonotum, if the fusion of the meso- and pronotum can thus be styled (Fig. Cf and Fig. Eh).

Measurements to the hundredth of a mm were made of these different types. The averages and the extremes in size are shown in these tables following. The differences in the size of the heads are due almost entirely to the position of the mandibles, some of the specimens having them closed, others open.

Table of Averages.

Form	Length of				Thoracic	
	Head	Thorax	Abdomen	Body	Thickness	Width
Queen	.84	1.67	1.45	3.13	.69	.58
Microgyne	.96	1.79	1.22	3.01	.71	.60
Ergatoid	.97	1.68	1.45	3.09	.64	.62
Triocellate	.95	1.52	1.58	3.17	.52	.51
Biocellate	.92	1.49	1.48	2.97	.48	.50
Uniocellate	.93	1.45	1.45	2.90	.50	.53
Macroergate	.86	1.55	1.55	3.17	.51	.49
Microergate	.89	1.37	1.06	2.43	.45	.48

Table of extremes: largest and smallest.

Form	Length of				Thoracic	
	Head	Thorax	Abdomen	Body	Thickness	Width
Queen	1.	1.8	1.5	3.3	.7	.6
	.8	1.8	1.2	3.0	.7	.5
Microgyne	1.	1.7	1.4	3.1	.8	.6
	.9	1.8	1.1	2.9	.7	.5
Ergatoid	1.	1.8	1.6	3.4	.7	.6
	1.	1.5	1.2	2.7	.6	.6
Triocellate	1.	1.8	1.9	3.7	.6	.5
	1.	1.1	1.3	2.4	.5	.5
Biocellate	.9	1.5	1.6	3.3	.5	.5
	.9	1.4	1.2	2.6	.5	.4
Uniocellate	.9	1.5	1.6	3.1	.6	.7
	.9	1.5	1.2	2.7	.5	.5
Macroergates	.9	2.3	1.8	4.1	.4	.6
	.8	1.3	1.2	2.5	.5	.4
Microergates	.7	1.5	1.3	2.8	.5	.7
	1.	1.2	.9	2.3	.5	.5

The following table shows the extremes of the respective parts of the body. No one ant furnishes these measurements but usually five or more different ones out of from twenty five to fifty individuals.

Table of Ideal Ants: largest and smallest.

Form	Length of				Thoracic	
	Head	Thorax	Abdomen	Body	Thickness	Width
Queen	1. .8	1.8 1.5	1.8 1.2	3.6 2.7	.8 .6	.6 .5
Microgyne	1.1 .9	1.9 1.6	1.4 1.1	3.3 2.7	.8 .6	.7 .5
Ergatoid	1.2 .8	1.9 1.5	1.7 1.2	3.6 2.7	.8 .5	.7 .5
Triocellate	.9 1.2	1.2 1.9	1. 1.9	2.2 3.8	.4 .6	.4 .6
Biocellate	1. .8	1.7 1.3	1.6 1.2	3.3 2.5	.6 .4	.6 .4
Uniocellate	.9 1.	1.3 1.5	1.2 1.6	2.5 3.3	.4 .6	.4 .6
Macroërgate	.8 1.1	1.3 2.3	1.2 2.1	2.5 4.4	.4 .8	.4 .7
Microërgate	1.1 .7	1.6 1.2	1.3 .9	2.9 2.1	.5 .4	.7 .4

One thousand specimens were examined and counted. They were divided as follows: males 111, winged queens 26, microgynes 10, ergatoid females 16, triocellate workers 276 — VIIIa 36, VIIIb 126, VII 114 —. biocellate workers 17, uniocellate workers 8, macroërgates 429, microërgates 107. In the biocellate group 12 have the posterior ocelli, 3 have the left posterior and the anterior, 2 have the right posterior and the anterior. In the uniocellate group 3 have the anterior ocellus, 3 have the right posterior and 2 have the left posterior. In addition to these one thousand specimens (taken from upwards of twenty nests) two nests A and B, had been preserved separately and contained 196 and 87 individuals respectively. A contained the following: ergatoid 3, triocellate workers 36, biocellate 11, macroërgates 44, microërgates 12. B contained: males 6, ergatoid 4, triocellate 36, biocellate 3, uniocellate 1, macroërgates 23, microërgates 9. In the triocellate workers of nest A one has the large scutellum, five have the small scutellum, and thirty have the escutellate structure. Of the biocellate workers seven have the posterior pair of ocelli, three have the right posterior and the anterior, one has the left posterior and the anterior. In nest B one of the triocellate workers has the large scutellum, eight have the small scutellum, seven are escutellate. One of the biocellate workers has the posterior pair of ocelli, two have the left posterior and the anterior. The uniocellate individual has the right posterior ocellus.

Specimens were now dissected to determine the condition of the ovaries, in which a great deal of variation was expected. In three queens that were examined, the ovaries were normally developed and varied in the number of tubules; two individuals had two tubules on each side, two eggs to each tubule. The typical receptaculum seminis was present, situated in the middle of the vagina, almost at the distal end (Fig. Fa).

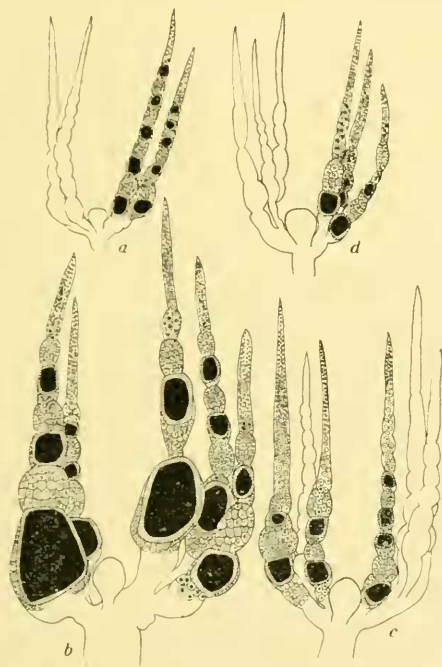


Fig. F.

Leptothorax emersoni WHEELER.

a Ovary of queen, type XI; b Ovary of ergatoid female, type IX;
c Ovary of biocellate worker, type VI; d Ovary of microergate, type I.

A microgyné had well developed ovaries, several eggs being present in each tubule. The tubules varied in number; one specimen had two on each side, the other had two on one side and three on the other; as was to be expected. The typical receptaculum was present here also.

The ergatoid forms possessed normal and exceedingly well developed ovaries, the number of tubules varying here also. Two spe-

cimens had three tubules to each side, two had three on one side and two on the other. The typical receptaculum seminis was present on all of the ovaries (Fig. Fb).

Triocellate workers with the large scutellum were next examined and the ovaries were found to be so well developed as to cause surprise. Two had three tubules on each side, three had three tubules on one side and two on the other, two had two on each side. The receptaculum was observed in all the ovaries except one, where its presence was not certain owing to an unfortunate position assumed by the organ when mounted. The triocellate worker with the small scutellum had well developed ovaries also; two specimens had three tubules to each side, two had two on each side. Again the receptaculum was present in all the ovaries. The triocellate escutellate workers had exceedingly well developed ovaries, one individual having very much larger ovaries than the queen. Two of these workers had three tubules on each side, one had four on one side and three on the other, one had two on each side. The receptaculum was present in every case!

The biocellate forms had three tubules on one side and two on the other, six eggs to each tubule, and the typical receptaculum seminis on the vagina (Fig. Fc).

The receptaculum was also present in the ovaries of the uniocellate workers; the tubules varied in number, some individuals having two tubules on each side, others having three on one side and two on the other.

The macroergates possessed a greater number of tubules. Four specimens had three tubules on each side, one had three on one side and two on the other; the receptaculum was present in all cases.

The microergates also had well developed ovaries, there being as many as seven eggs to each tubule. Six individuals had three tubules on each side, three had two on each side, two had two and three tubules respectively on each side. The ovaries were large and as well developed as those of the queen. The receptaculum was observed in all cases except one where it did not seem to be present (Fig. Fd).

Throughout the entire series the number of tubules varied between two and three on each side; the receptaculum seminis was observed in all the cases except two, which were doubtful. The ovaries of the queen were smaller than those of any of the

other forms. The number of eggs in each tubule varied both on the two sides of the same ovary and in the ovaries of different individuals of the same type, as also in those of different types.

The variation in the size of the ovaries in the different types is readily seen in the following table:

Form	Length of ovary in mm
Queen	.6
Microgyne	.6
Ergatoid	.8
Triocellate	1.3—1.4
Biocellate	1.
Uniocellate	.7
Macroergate	.9
Microergate	.8

If ADLERZ's statement is correct, that all ants possessing the receptaculum seminis are to be considered as queens, then we have in these one thousand specimens 887 queens, 111 males, and two individuals which may be queens, if calculations are based on the results obtained.

Conditions homologous to those occurring in *Leptothorax emersoni* were next sought for in other species of the same genus. *L. longispinosus* ROG., *L. curvispinosus* MAYR, a variety of the latter, *L. obturator* WHEELER, *L. canadensis* PROV., were the representatives used. The sexual phases are represented by males, queens, macro- and microergates. No ergatoid nor ocellate workers were found in any of these species with the exception of *Leptothorax canadensis*. In two nests of this last species three ocellate workers were found, one possessing three ocelli, one possessing two ocelli in the posterior position, and one individual with the anterior ocellus. The workers of this species all show the same thoracic structure, which shows a great simplification: the three thoracic segments are indicated by furrows; all the parts have fused with the exception of the sternite of the mesothorax. The queen is very nearly typical, a slight reduction has taken place, however; laterally the parts of the segments have begun to fuse. A few specimens of each were dissected to determine the condition of the ovaries in the workers. The ovaries possessed only a single tubule to a side, no receptaculum seminis was found. Usually several eggs were present in a tubule; sometimes, however, only one egg was present, sometimes none.

III. Other Ergatoid Forms.

Ergatoid forms of several other different species belonging to Dr. WHEELER'S collection were placed at my disposal for study. Unfortunately these forms are too rare to be sacrificed for dissection, and therefore a description of the external structure must suffice until sufficient fresh material is obtained to carry on a study of the internal anatomy. It is assumed that these forms functioned as queens.

Ponera opaciceps MAYR.

Two ergatoid females of *Ponera opaciceps* were collected along with many ordinary workers, by Dr. WHEELER in Mexico. The ergatoid forms differ from the ordinary workers in the size of the

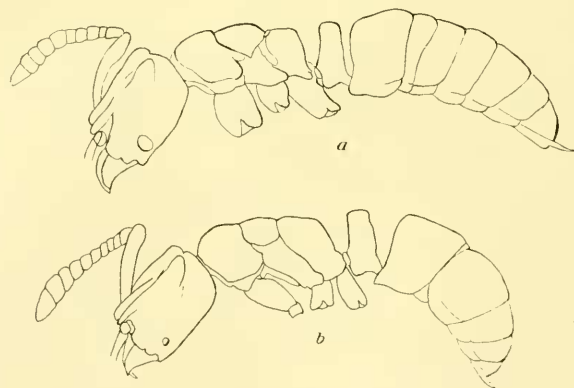


Fig. G.

Ponera opaciceps MAYR.

a ergatoid female; b worker.

eyes and the structure of the thorax. The eyes of the ergatoid are much larger than those of the ordinary workers, containing about fifty-three facets, closely and regularly arranged; the eyes of the worker contained only about ten facets, irregularly arranged and not at all crowded. In the structure of the thorax very little difference is shown; in the region of the paraptera the segments have not become fused to such an extent in the ergatoid form as in the worker (Fig. G a and b). In coloring, shape of head and abdomen the two forms are identical. Unfortunately no queen was

found with which to compare these forms. A rather strange thing was the absence of ocelli in the ergatoid form.

Ponera coarctata var. *pennsylvanica* BUCKLEY.

A single ergatoid form of this species occurred in a nest composed of males, queens and workers, taken at Colebrook, Conn., and another was taken at Rockford, Ill. They differ from the queen in the structure of the thorax. In the queen the pronotum and sternite have fused; the mesonotum, tegulae, paraptera, scutellum and epimerite are distinctly separated. The wings are present; the sternite and episternite have fused. The metanotum is distinct; the other parts of the metathorax have fused with the epinotum.

In the ergatoids the pronotum, mesonotum, paraptera, scutellum, metanotum and epinotum are distinct; the other parts have fused. The eyes of the ergatoids are as large as those of the queen and

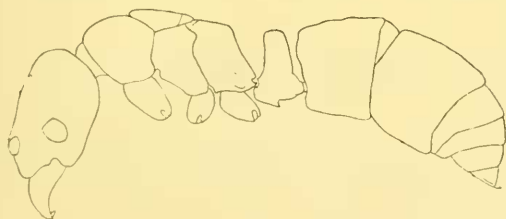


Fig. H.

Ponera coarctata LATR. var. *pennsylvanica* BUCKLEY.

Ergatoid female.

contain about fifty-eight facets (Fig. H). The three ocelli are present in both forms.

The thorax of the worker has the pronotum, mesonotum and epinotum distinctly separated; the remaining parts have fused. The eyes are very small and contain about ten facets.

Cremastogaster minutissima MAYR.

The *Cremastogaster minutissima* usually has several queens present in the nest, a condition very infrequent in our species of *Cremastogaster*. In a single nest, which was taken at New Braunfels, Texas, three ergatoids were found, along with queens, large and small workers, eggs and larvae. In size the ergatoids approach the queen.

The queen has the typical prothorax; the mesonotum, tegulae, paraptera, scutellum and sternite of the mesothorax are distinct; the epimerite and episternite of the mesothorax have fused. In the metathoracic segment the metanotum and epimerite are distinct, the episternite and epinotum have fused. The orifice of the scent gland is located in this segment.

The ergatoid has a slight demarcation between the pro- and meso-notum. The position of the epinotum is slightly indicated by a faint suture. The eyes are large, composed of large, regularly arranged facets, sixty-four in number. Three small ocelli are present (Fig. J).



Fig. J.

Cremastogaster minutissima MAYR.

Ergatoid female.

The following table shows the relative size of the different parts of the queen and ergatoid form:

Form	Length of			Thoracic	
	Head	Thorax	Abdomen	Thickness	Width
Queen	.9	.8	3.1	1.1	.8
Ergatoid	1.	1.2	2.1	.6	.5

One of the ergatoid forms was dissected to determine the condition of the ovaries. They were in an undeveloped state; no eggs were present in the single tubules.

The queens have four tubules to each ovary, two on each side. One is much larger than the other and contains larger eggs; several eggs are present in each tubule.

The workers have only one tubule on each side, small and undeveloped: eggs are present in very few of them and are not mature.

Formica pallide-fulva LATR. *var. nitidiventris* EMERY.

In different nests of *Formica nitidiventris* taken at Colebrook, Conn., by Dr. WHEELER three peculiar microgynes were found. There is a very slight difference in the thoracic structure of the queen and these individuals. In the first two thoracic segments the queen has all the typical parts except that the epimerite and episternite have fused, and the suture between these and the sternite is a little less marked than is typical. In the metathorax the episternite and sternite have fused, the metanotum, epinotum and epimerite are distinctly separated.

The structure of the pro- and meso-thorax of the microgyne is exactly like that of the queen, but in the metathorax the epinotum has fused with the episternite and sternite. A very interesting fact in connection with the microgynes is that they have returned to the coloring of the typical *schaufussi* MAYR, which is a bright yellow although the coloring of the queen and workers of *F. nitidiventris* is dark brown.

The following gives the relative sizes of the queen and microgynes:

Form	Length of				Thoracic	
	Head	Thorax	Abdomen	Body	Thickness	Width
Queen	2.2	3.9	3.1	7.	2.1	2.2
Microgyne	1.9	2.9	2.2	5.1	1.2	1.

Camponotus maculatus FABR. *subsp. vicinus* MAYR
var. nitidiventris EMERY.

In a nest of *C. m. vicinus var. nitidiventris* collected in San Jose, California, by Dr. HAROLD HEATH, two pseudogynes occurred. The nest of this ant contained males, queens, soldiers and workers. These two specimens are of the same size as the soldiers, from which they differ in thoracic structure mainly. The pseudogynic forms, however, are not alike. One has the same coloring as the worker, the other is very much darker, in fact almost black. The abdomen is larger than that of the worker, but not nearly so large as that of the soldier.

The queen has very nearly a typical thorax: the epimerite and episternite of the mesothorax have fused, and the demarcation between these and the sternite is very slight, as is also the separation

between the meso- and meta-thorax. The episternite, sternite and epinotum of the metathorax are very faintly indicated; indeed, laterally the parts of the two last thoracic segments, as well as the segments themselves have become very nearly fused.

The soldier has the typical prothorax. On the dorsal aspect the mesonotum, a small metanotum and the epinotum are distinct; laterally, however, these begin to fuse with the lateral parts and become indistinct. The tegulae are present. The episternite and epimerite of the mesothorax have fused with the sternite and are separated from the mesonotum by a faint suture only. In the meta-thorax the epinotum, sternite, episternite, and epimerite have completely fused.

The worker has the pro-, meso- and meta-thorax distinctly separated dorsally, but they have fused with the other parts laterally

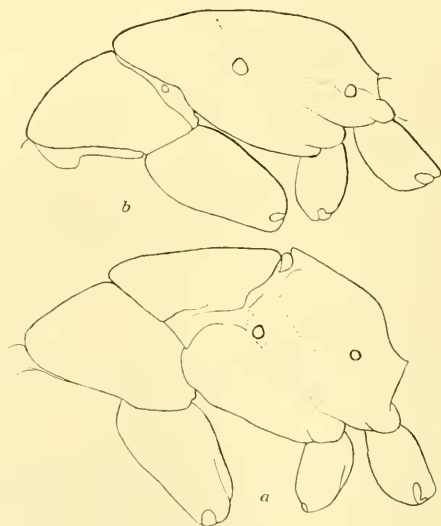


Fig. K.

Camponotus maculatus FABR. subsp. *vicinus* MAYR var. *nitidiventris* EMERY.

a Pseudogyne, exhibiting the coloring of the worker; b The pseudogyne of dark color.

and are indistinguishable; in fact the meso- and meta-thorax have fused, and are separated from the pronotum by a slight furrow only.

The pseudogyne possessing the coloring of the worker has the pronotum, mesonotum, scutellum and metanotum distinctly separated

dorsally; laterally, however, the scutellum is not at all distinct, and the metanotum has fused with the adjoining parts. The pronotum, mesonotum and tegulae are distinct, everything else has fused, even to an obliteration of the sutures between the meso- and meta-thorax. No ocelli are present (Fig. Ka).

The specimen with the dark coloring has even fewer parts distinct, the scutellum has fused with the mesonotum; dorsally the metanotum is distinctly marked off but laterally it fuses with the epimerite of the third thoracic segment; the epimerite of the meso-thorax is distinct, all the other parts have fused. No ocelli are present (Fig. Kb).

Cryptocerus aztecus FOREL.

In a nest of *Cryptocerus aztecus* collected at Cuernavaca, Mexico, by Dr. WM. M. WHEELER, a soldier was found possessing rudimentary anterior wings; no traces even of posterior sutures existed! As no form similar to this has ever been recorded a description of this peculiar individual does not seem out of place.

The queen of this species was not found but that of a kindred species has been described by FOREL and possesses the typical thoracic structure.

In the soldier the structure of the thorax is very simple. The three thoracic segments are distinctly separated, both dorsally and laterally; the parts of the segments have fused completely.

The specimen possessing the rudimentary fore wings is exactly like the soldier in every other respect. The wings are attached to the prongs of the mesothorax.

The typical worker of this species shows still further simplification. Laterally the thoracic segments are distinct but dorsally the pro- and meso-thorax have fused, and the prongs, which are so prominent in the soldier, are modified.

Pheidole ceres WHEELER.

Another case of apparent atavism, similar to that shown by the microgyne of *F. nitidiventris*, is exhibited by a microgyne of *Pheidole ceres*, belonging to a nest taken at Boulder, Col. by Rev. P. J. SCHMITT, O. S. B. In addition to the microgyne the nest contained a true queen, soldiers and workers, twenty-three individuals in all. The queen, soldiers and workers are dark brown, indeed almost black

in color, but the microgyne is a light yellow. These ants possess the large heads and huge mandibles typical of many species of

Pheidole possessing similar habits. The figures show the relative sizes and differences in the structure of the four forms (Fig. L).

The queen possesses almost a typical thoracic structure, with the exception that the demarcation between the pro- and meso-notum is slight, the epimerite and episternite have fused; the demarcation between the parts of the metathorax seem to be disappearing. The second node is large and very broad, in fact it is nearly as broad as the abdomen. Three ocelli are present and also the stumps of the wings.

The microgyne also exhibits a difference in the thoracic structure

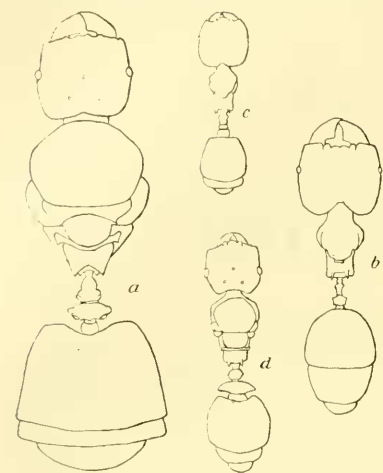


Fig. L.

Pheidole ceres WHEELER.

a Queen, b Soldier, c Worker,
d Microgyne.

as well as in coloring and sculpturing; a reduction or simplification having taken place. The scutellum is not so distinct as in the queen; the epimerite and episternite of the mesothorax have fused and the demarcation between the meta- and epinotum is slight. The microgyne, like the queen, possesses three small ocelli, the large, broad second node and the wing stumps. Although the thorax of the microgyne is much broader than that of the soldier, the soldier is really the larger.

In the soldiers a still further reduction of thoracic structure occurs; dorsally the pro-, meso-, meta- and epi-notum and scutellum are present, but their position is denoted not by sutures but by the difference in sculpturing; laterally the meso- and metanotum are slightly indicated; the three thoracic segments are distinct but the parts of these have fused, with the exception of the sternite of the mesothorax.

The worker shows the three thoracic segments but all the parts have fused on the lateral aspect; dorsally the pro-, meso- and meta-notum have fused, the epinotum is distinct. The different parts here

are distinguishable also, in the main, by the differences in the sculpturing.

IV. Observations on some Doryline and Camponotine Ants.

In the *Dorylinae* and *Camponotinae* we should expect to find extremes in the development of the ovaries of the queen and worker. This was found to be true to a certain extent; in the former subfamily specialization has gone so far that the ovaries of the queen are very large while those of the worker are very rudimentary indeed, in the other specialization has not gone so far and therefore the differences between the ovaries of the queen and worker are not so great.

Eciton schmitti EMERY.

While a nest of *Eciton schmitti* was being excavated the head of the queen was accidentally cut off and she was immediately brought in to be studied as the queen of this species had never been dissected. After being brought to the laboratory this decapitated queen deposited about fifty eggs before she could be dissected, and indeed whenever the needles touched the chitin of the abdomen eggs were thrown out in great numbers. The abdomen was very much distended and the ovaries were in a very mature condition, and filled the entire body cavity. From the vagina two long oviducts extended the entire length of the ovary, and into each oviduct innumerable tubules, filled with mature eggs, poured their contents. The drawing of necessity had to be very diagrammatic and fails to show anything like the true number of tubules. One hundred and sixty-two were counted on half of one side, so that the total number of tubules could not be far from five hundred. The tubules reached almost to the vagina along the oviduct. On the vagina occurred the receptaculum seminis of rather large size, apparently a necessary adaptation to the large number of eggs to be fertilized. That many of these are mature at a time is indicated by the fact that half of the tubules on each side contains several ripe eggs. The tubules



Fig. M.

Eciton schmitti EMERY.

Ovary of the queen showing the vagina, receptaculum and very diagrammatically represented tubules.

themselves are long and slender, containing from six to twelve eggs, separated by clusters of nurse cells and surrounded by follicles, in the usual manner (Fig. M).

Dissection of adult workers failed to show any ovaries, but as the workers of these species are very small it was thought that they possibly were overlooked. Sections of advanced pupae failed to show any trace of them, however. If present they are very rudimentary indeed, and perhaps for that reason make their appearance late.

Camp. (Colobopsis) abditus FOREL *var. etiolatus* WHEELER.

The *Camponotus etiolatus* are found in the Cynipid galls on the live oak. The queen is very seldom found; in nearly every nest examined larvae and eggs are present, however. The worker form is represented by soldiers, or large headed workers, and by small workers. It was thought that here as in the *Pachycondyla harpax*, the large workers could function as queens, but the ovaries are not well developed and have only one tubule to a side. The queen dissected had six tubules on one side and seven on the other, with from six to eight eggs in each tubule.

In the soldier there was only one tubule to a side, as was stated, and usually there was only one egg to a tubule; sometimes, however, there were two. No receptaculum was present in the ovaries of the soldier.

The same number of tubules occur in the small worker, that is, one on each side; but they are in a more developed state, there being usually two, sometimes even three eggs to a tubule.

The first few specimens dissected possessed a bilobed organ, which looked, as far as its position was concerned, as if it were the receptaculum seminis; this was doubtful, however, on account of its large size, it being much larger than the ovary. However, an examination of thirty specimens showed it to be the accessory gland on the anal gland, very similar to that described by FOREL in connection with the anal gland in *Formica rufibarbis* worker. It is situated between the anal gland and the ovary and is joined to the former near its base; the vagina ends anteriorly to its opening.

The soldiers as far as could be determined on alcoholic specimens, did not possess this gland.

Camponotus marginatus LATR.

Another ant which occurs abundantly around Austin, living in the Holsaspis galls on the live oak, is a variety of *Camponotus marginatus*. The queen is always present in the nest and so a high development of the ovaries of the worker was not expected. The queen had twelve tubules on each side, eleven mm long, and very slender; in fact they are very much longer than the abdomen of the queen and are therefore folded upon themselves. There are about thirty eggs in each tubule (Fig. Na).

The soldiers have not nearly so many tubules; the highest being three on one side, four on the other, the lowest number being one on each side. Some had two on each side. Well developed ovaries were present in one of the ovaries, others had no eggs whatever. No receptaculum was present (Fig. Nb).

The macroergates had only one tubule on each side; in some of the workers the ovaries contained as many as five and six eggs on each side, most of them had two and three eggs to a tubule.

The microergates had one tubule to each side, in all cases except one where there were two very short ones on one side and one of ordinary length on the other (Fig. Nc).

All the workers of the *Camponotus marginatus* seemed to possess the bilobed gland in connection with the anal gland as in the *Colopobsis*. It was not found in the queen, however.

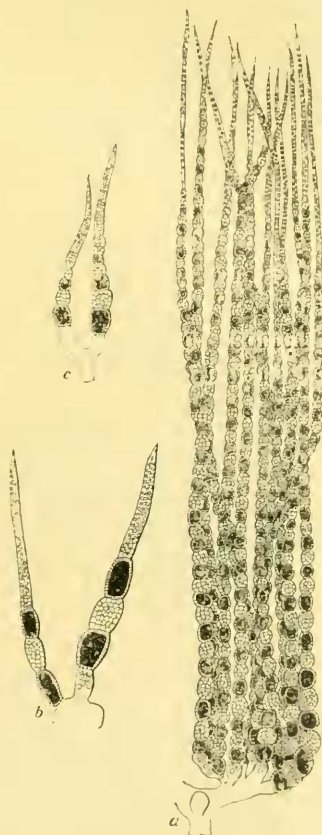


Fig. N.

Camponotus marginatus LATR. var.

a Ovary of queen, showing the vagina, receptaculum and the tubules of one side; b Ovary of soldier; e Ovary of worker.

Camponotus fumides var. festinatus BUCKLEY.

This species of *Camponotus* is very abundant in the vicinity of Austin, and is very conspicuous on account of its large size and bright yellow color. The queen is of frequent occurrence and a differentiation of the reproductive organs of the females forms was expected. The queen has between fifteen and eighteen tubules on each side of the ovary, the tubules are long and slender, and contain fifteen to twenty eggs each. The ovaries of this ant resemble those of *C. marginatus* very much, the only difference noticeable being a small increase in the size of the tubules. The typical receptaculum seminis was present.

The soldiers have not so many tubules as the queen but their ovaries are well developed and each tubule contains several eggs, some of which in every case were mature. The tubules being fewer in number could be counted readily. The variations were so great that they are given in the following table:

Form	No. of Ovaries	No. of Tubules
Soldier	4	3 and 3
	6	2 " 2
	4	1 " 1
	4	3 " 2
	2	5 " 6
	1	5 " 11
	1	5 " 7

No receptaculum seminis was present (Fig. Oa).

The workers showed a greater reduction in the number of tubules, the highest number reached being two on one side and one on the other; only two specimens showed this condition, while thirty possessed a single tubule on each side, which, however, were well developed and contained normal and mature eggs. Among these thirty-two ovaries two specimens were found with the receptaculum situated in the usual position on the vagina between the tubules (Fig. Ob). Nine specimens exhibited a very peculiar structure; on one tubule was situated a sac like structure, which had it occupied the usual position on the vagina would immediately have been recognized as the receptaculum seminis, but owing to its abnormal position its function is not certain (Fig. Oc).

It is either the receptaculum or a rudimentary egg tubule. However, its huge size and spherical shape makes the latter doubtful, and as sections showed it to be a spherical sac with epithelial walls, containing nothing so far as could be determined with ordinary methods, and since in some specimens it empties into the tubule very near to the true vagina, it is believed to be the receptaculum seminis. In some ovaries it is attached to the outer side of the tubule, in others to the inner side. If this organ is the receptaculum it must be that the eggs from one tubule only are fertilized, those of the other tubule passing out unfertilized.

The accessory gland was present in all the forms dissected, queen, soldiers and workers.

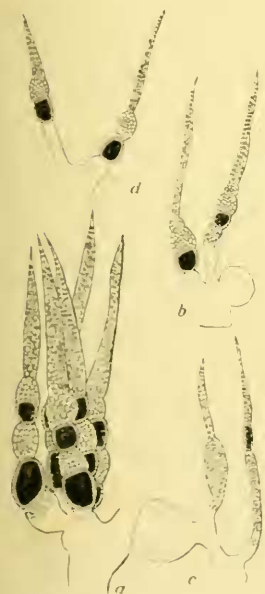


Fig. O.

Fig. O. *Camponotus fumides* var. *festinatus* BUCKLEY. a Ovary of soldier; b Ovary of worker, possessing a typical receptaculum; c Ovary of worker with receptaculum on one tubule; d Ovary of worker.

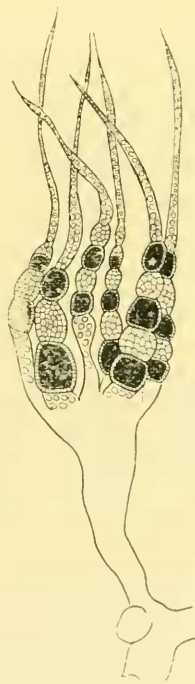


Fig. P.

Fig. P. *Camponotus maculatus* McCook var. *sansabeanus* BUCKLEY. Ovary of queen, showing the vagina, receptaculum and the tubules of one side.

Camponotus maculatus McCook var. *sansabeanus* BUCKLEY.

The queen of *C. maculatus sansabeanus* possesses six or seven tubules to a side usually; one specimen, however, had seventeen.

tubules to each side. The receptaculum is present in the usual position (Fig. P).

The worker phase here is represented by soldiers, macroergates and microergates. The soldier has only one tubule to a side, with one egg, or at most two, to a tubule. The accessory gland is present here also, situated between the ovary and the anal gland.

The macro- and micro-ergates also have only one tubule to a side, and one egg in each. The accessory gland is present in both forms.

Pogonomyrmex barbatus SMITH *var. molifaciens* BUCKLEY.

Although the nest of this ant is so abundant and although the young queens may be obtained in great numbers during the marriage flight, it is very difficult to obtain a queen that has presided over a colony, as the nests are so large and the queen located at such a depth in the immense nest. However, one of these queens, which had been at the head of a very large colony, was obtained this spring.

The ovaries of this queen were large and well developed, possessing from twenty-five to thirty tubules to a side, with about fifteen eggs in each tubule. The ovary resembled very much that of *C. maculatus sansabeanus* with the exception of the increase in the number of tubules. The receptaculum seminis was large and bilobed; the ovary was 3.2 mm long.

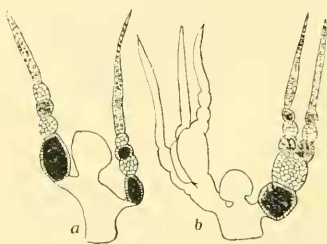


Fig. Q.

Pogonomyrmex barbatus SMITH
var. molifaciens BUCKLEY.

a and b Ovaries of workers, possessing a typical receptaculum seminis.

The workers showed a great reduction in the number of tubules, the highest number reached being seven on one side; usually the number is less. Although the workers dissected showed no external differences, sixteen ovaries possessed the receptaculum

seminis, while nineteen did not. The receptaculum of the workers did not show the bilobed structure, but was a simple spherical sac (Fig. Q a and b).

The following table (page 323) gives the variation in the number of tubules in the workers.

Form	No. of Ovaries	No. of Tubules
Worker with receptaculum	1	6 and 3
	2	4 " 4
	1	4 " 3
	1	3 " 3
	6	3 " 2
	4	2 " 1
Worker	1	7 " 3
	3	3 " 3
	7	3 " 2
	1	3 " 1
	5	2 " 2
	2	2 " 1

Summary.

1. The queens and workers of *Leptogenys elongata* BUCKLEY differ very little in external anatomy. Two types of ovaries were found in the queens dissected; the one had long, slender tubules, two on each side, about fifteen eggs in each; the other had short tubules, varying from two to three on each side, with only two or three eggs in each. The typical receptaculum seminis was present in both types. The workers possessed two or three tubules on each side. One worker, showing no difference in external structure, possessed the typical receptaculum seminis!

2. The queens and workers of *Pachycondyla harpax* FABR., also differ little in external anatomy. The queen is seldom found in the commonly occurring nests, but pupae and larvae are usually found. The ovaries of the queen had from five to seven tubules on each side and the typical receptaculum seminis. Seven specimens out of thirty-seven workers possessed a receptaculum. The ovaries of the receptaculate workers had longer tubules and therefore more eggs in each than those of the ordinary worker. The tubules in the workers varied from two to nine on each side; they were well developed and contained mature eggs.

3. The queens and workers of *Odontomachus clarus* ROG., also are very similar in external anatomy. The ovaries of the queen, possessing five tubules on each side, were well developed; the receptaculum seminis had attached to it, by a slender tube, a tri-lobed organ, apparently a gland. Ten receptaculate workers possessed this gland also; the ovaries had well developed tubules, varying in number from three to eight on each side. The ovaries of

ordinary workers also were well developed and contained mature eggs; the tubules varied from two to eight on each side.

4. *Leptothorax emersoni* WHEELER presents eleven different types of female individuals, distinguished by external anatomy: queen, microgyne, ergatoid female, tri-ocellate large scutellate form, tri-ocellate small scutellate form, tri-ocellate escutellate form, bi-ocellate large scutellate, bi-ocellate small scutellate, bi-ocellate escutellate, uni-ocellate large and small scutellate forms, uni-ocellate escutellate form, macroërgate and microërgate. All eleven types possessed well developed ovaries, containing mature eggs; they had from two to four tubules on a side; the number of eggs in each tubule varied both on the two sides of the same ovary and in the ovaries of different individuals of the same type, as also in those of different types. All the specimens dissected had better developed ovaries than the queen. Every individual dissected, except two, possessed the receptaculum seminis!

5. In *Leptothorax longispinosus* ROG., *L. curvispinosus* MAYR, *L. obturator* WHEELER and *L. canadensis* PROV., the sexual phases are represented by males, queens, macro- and micro-ergates. No ergatoid females were found in these species. Among *L. canadensis* one tri-, one bi-, and one uni-ocellate worker were present. The queens and workers showed a difference in external structure. The ovaries of the workers possessed a single tubule on each side. No receptaculum seminis was present!

6. Ergatoid females of *Ponera opaciceps* MAYR, *Ponera coarctata* var. *pennsylvanica* BUCKLEY and *Cremastogaster minutissima* MAYR were found. Two ergatoids of *P. opaciceps* differed from the worker in the size of the eyes, which are larger, and in the structure of the thorax, where fusion had not progressed so far as in the worker. No ocelli were present in these ergatogynic forms! *P. coarctata pennsylvanica* had ergatoid forms differing from the queen in the structure of the thorax only; fusion had taken place in the thorax of the ergatoids. Three ergatoids of *C. minutissima* were distinguished from the queen by the simplification of thoracic structure. The ovaries of the ergatoid females had one tubule to a side and contained no eggs. No receptaculum was present! The queen had two tubules on each side and contained mature eggs.

7. Three microgynes of *P. pallide-fulva nitidiventris* EMERY occurred in a single nest. They differed from the queen by a slight variation in thoracic structure; fusion had taken place in the metathoracic

region. The microgynes had returned in coloring to that of the typical *schaufulsi* MAYR.

8. Two pseudogynes of *C. maculatus vicinus var. nitidiventris* EMERY approaching the soldier in size, differed from each other in color; the one having the coloring of the worker, the other was almost black; and in thoracic structure, simplification having progressed further in the one than in the other.

9. A very peculiar specimen of *Cryptocerus aztecus* FOREL was collected in Mexico: it is exactly like the soldier in every respect except that it possessed rudimentary anterior wings; no traces even of posterior sutures existed, however.

10. Another case of atavism was shown by a microgyne of *Pheidole ceres* WHEELER, which was light yellow in color while the queen, soldiers and workers were dark brown. The microgyne showed a simplification in thoracic structure also.

11. Some Doryline and Camponotine ants were studied to determine if specialization has taken place in the reproductive organs corresponding to the differentiation of external structure.

12. The queen of *Eciton schmitti* EMERY possessed a very highly specialized ovary. There were about three hundred tubules on each side, which emptied into a slender oviduct, extending the entire length of the ovary. The receptaculum seminis was very large, probably an adaptation to the great number of eggs to be fertilized. No ovaries were found in any of the workers.

13. The sexual phases of *C. (Colobopsis) abditus* FOREL *var. tiolata* WHEELER are represented by males, queens and workers. The queen is seldom found; the one queen obtained had well developed ovaries, six and seven tubules on each side. The ovaries of the soldiers were not well developed, possessing only one tubule on a side, as was also the case with the workers; these ovaries did not possess the receptaculum. A bilobed accessory gland occurred on the anal gland.

14. *C. marginatus* LATR. also showed a very high differentiation between the sexual forms. The queen had very long, slender tubules, twelve to each side, about thirty eggs in each. The soldiers had from one to four on each side. The macro- and micro-ergates had only one tubule on each side, containing mature well developed eggs, however. No receptaculum was present except in the queen. The workers of this species also possessed the bilobed accessory anal gland.

15. The *Camponotus fumidus var. festinata* BUCKLEY queens pos-

sessed from fifteen to eighteen tubules on each side, with fifteen to twenty eggs each. The soldiers had well developed ovaries, tubules varying from one to seven on each side. The workers had from one to two tubules, usually just one, on each side. No receptaculum was found among the soldiers. Out of thirty-two workers dissected two had the receptaculum situated on one of the tubules, sometimes on the inner, sometimes on the outer, surface. The accessory anal gland was present in the queen, soldiers and workers.

16. *C. maculatus sansabeanus* BUCKLEY queens had from six to seven tubules usually; one had seventeen, on each side. The soldiers and workers had only one tubule to a side, one egg in each usually. The accessory anal gland was present also in this species.

17. In *Pogonomyrmex barbatus* SMITH var. *molifaciens* BUCKLEY the queen had large and well developed ovaries, possessing from twenty five to thirty tubules on each side, fifteen eggs in each. The receptaculum of the queen was a large bilobed organ. The worker showed a reduction in the number of tubules; the number varied from one to seven tubules on each side, the usual number, however, was two or three. Sixteen workers possessed the receptaculum seminis, while nineteen did not. The receptaculum of the workers was not bilobed, but was a simple spherical sac.

18. The results of this investigation are in conformity with some of the prevalent ideas concerning the relative sexual conditions of the queens and workers of ants, but a variance with others. The workers of all species of ants cannot correctly be considered as sterile females, nor can the ovaries of workers be looked upon as rudimentary organs. While the ovaries of most of the species investigated do show a reduction in the number of tubules, they are not rudimentary, since morphologically and histologically they are capable of producing and do produce eggs.

It has been held by some that the intermediate conditions of fertility are induced by changes in social conditions, but the facts before us hardly warrant such a belief. It is true that *Leptothorax emersoni*, the ant which exhibits the greatest number of intermediate forms, virtually occupies the position of a parasite, but in contrast to this is the *Pogonomyrmex barbatus* possessing the receptaculum seminis in almost half of the workers dissected. Moreover the representative species of the Ponerinae studied are never parasitic and yet here too the receptaculum seminis occurs. A phylogenetic explanation seems to be the better one.

If ADLERZ's statement is true, that the presence of the receptaculum seminis indicates the capacity of performing the function of queen, then there is no physiological reason why those workers possessing the receptaculum should not have the power of performing the function of the sexual female, and it is believed that they do. His statement that the receptaculum seminis denotes the true queen of the colony is not borne out by the conditions existing in some of the ants investigated. The conditions existing in *Leptothorax emersoni* alone renders the last statement worthless as a general law. The condition in these ants, taken in connection with the conditions prevailing in the other species, shows that in general the presence of the receptaculum seminis is not peculiar to the queen ant and therefore cannot be used as a perfectly reliable means of distinguishing the queen from the workers, but must be taken in connection with all the other characteristic structures.

In conclusion I desire to express my gratitude to Dr. WM. M. WHEELER, under whose direction and inspiration this work has been done, for much of the material used, and for the many kind and helpful suggestions made.

Austin, Texas, June 1, 1902.

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